

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE MARYLAND GEOLOGICAL SURVEY, EDWARD
BENNETT MATHEWS, STATE GEOLOGIST; MARYLAND AGRICULTURAL
EXPERIMENT STATION, H. J. PATTERSON, DIRECTOR.

SOIL SURVEY OF WASHINGTON COUNTY,
MARYLAND.

BY

R. T. AVON BURKE, OF THE U. S. DEPARTMENT OF AGRICULTURE,
IN CHARGE, AND HERBERT F. McCALL, OF THE MARYLAND
AGRICULTURAL EXPERIMENT STATION.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1917.]



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., January 29, 1919.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of Washington County, Maryland, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law. This work was done in cooperation with the Maryland Geological Survey and the Maryland Agricultural Experiment Station.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Washington County sheet, Maryland.

SOIL SURVEY OF WASHINGTON COUNTY, MARYLAND.

By R. T. AVON BURKE, of the U. S. Department of Agriculture, In Charge, and HERBERT F. McCALL, of the Maryland Agricultural Experiment Station.—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

Washington County is situated in the northwestern part of Maryland, between the Potomac River, which lies on the south, and the Maryland-Pennsylvania line, on the north. Its greatest length east and west is $46\frac{3}{4}$ miles, and its greatest width $26\frac{3}{4}$ miles. The area included is 459 square miles, or 293,760 acres.

Washington County includes the western slope of the Blue Ridge, the important lowland belt known as the Hagerstown Valley, an extension of the Shenandoah Valley of Virginia, and in the west a part of the Appalachian Mountain system. The included Blue Ridge section is known as South Mountain. The Hagerstown Valley forms the eastern and central parts of the county and lies between the Blue Ridge and the Appalachian ridges. South Mountain, in the extreme eastern part of the county, is regarded as a northward extension of the Blue Ridge of Virginia. The highest peak in the Blue Ridge, which is also the highest point in the county, is Quirauk Mountain, which attains an elevation of 2,145 feet. The topography of the Blue Ridge is steep and mountainous. The Appalachian ridge belt comprises a series of mountain ridges traversing the area in a northeast and southwest direction separated by narrow and generally shallow valleys. The most conspicuous and prominent of these mountains occur in the eastern part of this division and are known as Bear Pond Mountain and Fairview Mountain. These attain altitudes of 2,000 feet and 1,700 feet, respectively, while Sideling Hill Mountain, in the extreme western part of the area, attains an elevation of about 1,600 feet above sea level. The topography of this general region is mountainous, but the mountains have comparatively smooth slopes, and are separated by narrow valleys in which the surface is rolling to hilly. The ridges are generally narrow, though in many places the tops are comparatively smooth and flat. A considerable proportion of the land in this region can be utilized for agriculture.

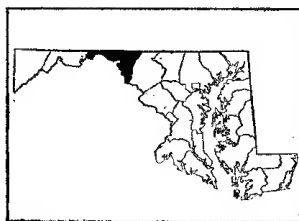


FIG. 1.—Sketch map showing location of the Washington County area, Maryland.

The Hagerstown Valley is the largest and most important division in the county, occupying more than one-half its area. It has an average elevation of about 450 feet above sea level, ranging from 300 feet at the Potomac River to 600 feet near the Pennsylvania line. The surface features vary from almost level or undulating to gently rolling, with here and there local hills which are comparatively steep. The slope to the water courses in this belt is gradual and the stream valleys in many places quite wide, with prevailingly flat bottoms. Slight sinklike depressions occur throughout this valley region. A few ridges of low altitude traverse it in a northeast and southwest direction. The largest one extends along Conococheague Creek from beyond the Pennsylvania line to the Potomac River. The topography of this ridge is more rolling than that of the valley region.

There is developed along the rivers and larger creeks a considerable area of bottom and terrace lands. The first bottoms are prevailingly flat and lie only a few feet above the normal water level of the streams. The terraces occupy relatively high positions and have in many places been eroded until their surfaces are rolling and broken.

Washington County lies within the Potomac River drainage basin, a number of important tributaries of the river flowing across the county in a general southerly direction. Branches of these larger creeks ramify in all directions and nearly every farm is reached by one or more such streams. It is thus a generally well-drained and well-watered county. In the Appalachian division the streams are swift-flowing and actively engaged in deepening their channels. The South Mountain division has no large stream, but contributes through a number of small swift streams to the waters of the valley division. In the valley region the streams have approached nearer their base level and their waters are more sluggish, flowing through wide flat bottoms, which in local places are not well drained.

Washington County as created by an act of the provincial convention of Maryland in 1776, included all of Western Maryland. The original settlers of the county were composed of Swiss, English, and Scotch, in addition to French from the border Provinces of Alsace and Lorraine. Some of the colonists had established their farms as early as 1735. The original settlers were followed by immigrants of Scotch-Irish, German, and Dutch nationality.

As early as 1800 Washington County was comparatively an old and settled region. Hagerstown and Williamsport were already commercial centers of importance, while many saw, lint, and woolen mills stood along the Conococheague and Antietam Creeks.

In 1790 the population of the county was 15,822. In 1820 many large plantations had been developed and the population had increased to 23,720, of which 3,898 were negroes.

The census of 1910 gives the total population of the county as 49,617, of which 16,507 is classed as urban and 33,110, or 66.73 per cent, as rural. The density of rural population is stated as 72.1 per square mile. Owing to the unequal distribution of the population, more than half of which is confined to the valleys, the density in the mountain regions is very much less than the figure given. From the best information at hand it is believed the total population (and especially the urban population) has increased considerably since 1910.

Within the limits of Washington County are the city of Hagerstown, with a population of 16,507, and the towns of Williamsport with 1,571, Sharpsburg, Hancock, and Boonsboro, 700 to 1,000; Funkstown, Clear Spring, Smithsburg, and Keedysville, 300 to 600, as well as numerous small villages and hamlets scattered throughout the area. Pen Mar, Pa., and Highfield are towns lying on the Maryland-Pennsylvania line. Hagerstown, the county seat, is an important railroad and manufacturing center.

Washington County has excellent transportation facilities. It is traversed by the Western Maryland Railway, the Cumberland Valley Railroad, the Baltimore & Ohio Railroad, and the Norfolk & Western Railroad. Transportation is also afforded by the electric lines connecting Hagerstown with Boonsboro, Frederick, and Williamsport, Md., and with Waynesboro, Pa.

Washington County has a good system of public highways. One of the best roads in the State, the Baltimore and Cumberland State Highway, extends through it. Most of the roads are macadamized and have been developed and maintained by toll companies.

Churches and schoolhouses are conveniently situated throughout the settled parts of the county. Telephone lines and rural mail routes extend to all parts of the area.

The larger towns of the county consume a considerable part of the farm produce. Much of the products shipped goes to Baltimore, Washington, Philadelphia, Pittsburgh, and Chicago.

CLIMATE.

Washington County has a temperate humid climate, with cold though not rigorous winters and pleasant summers in which excessive temperatures are not frequent nor heated periods ordinarily of long duration.

The mean annual temperature for the valley section, the only part for which the records are available, is, taking the mean of the three stations Clear Spring, Chewsville, and Keedysville, 52.4° F. The absolute maximums for these stations, respectively, are 98°, 101°, and 105° F., and the absolute minimums -16°, -27°, and -26° F.

The rainfall is sufficient for the growth of crops and is fairly evenly distributed through the year, being slightly greater in the summer season than in other seasons. The Clear Spring station reports a mean annual precipitation of 40.95 inches, Chewsville, 36.35 inches, and Keedysville, 36.63 inches.

The average date of the last killing frost in spring occurs in the latter half of April, and of the first in fall the latter part of October. From the records of the three stations quoted the average length of the growing season is 182 days.

Some departures from the conditions shown by the statistics given to exist in the valley may be expected to occur in the Blue Ridge and Appalachian divisions, but no stations of the Weather Bureau lie in these divisions in this county and therefore more definite information can not be given.

The following tables give the essential climatic data in detail:

Normal monthly, seasonal, and annual temperature and precipitation at Clear Spring.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1915).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	31.5	69	- 2	3.58	1.37	3.96
January.....	30.1	71	-16	3.39	4.10	5.67
February.....	27.7	65	- 1	2.55	3.70	4.49
Winter.....	29.8	71	-16	9.52	9.17	14.12
March.....	39.6	85	7	3.75	.71	.90
April.....	50.8	92	19	3.36	4.82	2.89
May.....	61.7	95	30	3.66	4.27	5.38
Spring.....	50.7	95	7	10.77	9.80	9.17
June.....	67.8	95	40	4.61	5.76	5.56
July.....	73.5	97	50	4.16	1.88	3.99
August.....	71.5	98	49	4.63	1.75	8.24
Summer.....	70.9	98	40	13.40	9.39	17.79
September.....	65.9	94	36	2.71	3.54	3.30
October.....	54.2	87	29	2.59	1.31	3.73
November.....	42.4	79	17	1.96	1.24	1.70
Fall.....	54.2	94	17	7.26	6.09	8.73
Year.....	51.4	98	-16	40.95	33.95	40.81

Killing frost: Average last in spring, Apr. 14; average first in fall, Oct. 27; latest in spring, May 12; earliest in fall, Oct. 11.

Normal monthly, seasonal, and annual temperature and precipitation at Keedysville.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1915).
	[°] F.	[°] F.	[°] F.	Inches.	Inches.	Inches.
December.....	33.3	70	-8	3.21	1.83	3.47
January.....	33.3	72	-26	3.31	4.28	6.07
February.....	31.2	68	-18	2.70	3.43	3.92
Winter.....	32.6	72	-26	9.22	9.54	13.46
March.....	40.0	85	4	30.3	.37	.91
April.....	53.5	97	20	2.98	5.54	.81
May.....	63.8	100	30	3.16	2.43	3.96
Spring.....	52.4	100	4	9.17	8.34	5.68
June.....	70.5	99	36	4.43	4.67	4.70
July.....	75.6	105	48	3.80	1.13	3.73
August.....	73.4	101	44	4.79	1.06	8.59
Summer.....	73.2	105	36	13.02	6.86	17.02
September.....	67.8	96	34	2.77	1.10	2.83
October.....	56.1	90	23	2.71	1.52	2.73
November.....	43.9	79	13	1.74	1.09	1.65
Fall.....	55.9	96	13	7.22	3.71	7.21
Year.....	53.7	105	-26	38.63	28.45	43.37

Killing frost: Average last in spring, Apr. 24; average first in fall, Oct. 20; latest in spring, May 16; earliest in fall, Oct. 1.

Normal monthly, seasonal, and annual temperature and precipitation at Chewsville.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1915).
	[°] F.	[°] F.	[°] F.	Inches.	Inches.	Inches.
December.....	32.3	70	-9	2.90	1.73	3.65
January.....	31.1	70	-27	2.98	3.03	6.07
February.....	29.4	68	-20	2.56	3.23	4.09
Winter.....	30.9	70	-27	8.44	7.99	13.81

Normal monthly, seasonal, and annual temperature and precipitation at Cheversville—Continued.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1910).	Total amount for the wettest year (1915).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
March.....	41.1	88	- 7	2.84	.08	.94
April.....	51.2	94	16	2.69	4.64	1.02
May.....	61.5	96	26	3.33	2.21	3.93
Spring.....	51.3	96	- 7	8.86	6.93	5.89
June.....	69.2	97	30	4.51	5.44	5.01
July.....	74.4	101	44	3.80	1.29	3.13
August.....	72.2	100	41	3.95	1.23	8.08
Summer.....	71.9	101	30	12.26	7.96	16.22
September.....	66.6	101	31	2.64	1.94	3.45
October.....	55.0	90	20	2.43	1.18	2.22
November....	42.8	78	1	1.92	1.12	1.36
Fall.....	54.8	101	1	6.99	4.24	7.03
Year.....	52.2	101	- 27	36.65	27.12	42.95

Killing frost: Average last in spring, Apr. 28; average first in fall, Oct. 16; latest in spring, May 27; earliest in fall, Sept. 28.

AGRICULTURE.

Agriculturally Washington is one of the best-developed counties in the State, the most important factor in this development being the production of the cereals, wheat and corn, which have been the principal crops from the earliest days of settlement. The present type of agriculture is probably best described as general farming, but dairy farming, fruit growing, and the feeding of live stock have become important industries. The principal crops to-day consist of wheat, corn, and hay, occupying an aggregate acreage of 42.5 per cent of the total area of the county, and more than three-fourths the area in field crops. The wheat crop is the most important, with an acreage, according to the census of 1910, of 57,299. This represents an increase of 4,307 acres over the year 1889, but is a decrease of 2,656 acres when compared with the acreage of 1899. Wheat is the principal money crop of the area. Little of it, however, is exported, most of it being sold to local mills. Most of the wheat grown is of bearded varieties, which are generally believed to be more prolific in this area than the beardless wheats. The popular varieties are Fulcaster and Miracle.

Corn is the next important crop. According to the census report of 1910, it occupied an acreage of 39,161. This represents an increase

of 7,251 acres over the acreage of 1899 and an increase of 6,329 acres over the acreage of 1889. Corn is largely used as a feed crop, displacing oats in this section to a great extent, but when prices are high a considerable part of the crop may be sold. Both white and yellow varieties are grown. The White Cap is the most popular variety around Hagerstown and Clear Spring Valley on account of its early maturity, large ears, and abundant fodder. Another popular variety is the Boone County White, utilized for silage and restricted largely to the dairy farms. The popular yellow varieties are Funks Yellow Dent and Reeds Yellow Dent. These are grown all over the county, and not restricted to certain sections, as in case of the white varieties mentioned, though most of the yellow corn is produced in the hill and mountain regions. A number of pure bred varieties of corn are produced in this county. They at present are only of local importance, but likely to have a decided influence on the future corn production. The most important of the white corns is Excelsior and of the yellow types Great Beauty.

Hay is the next crop of importance. According to the census of 1910 the acreage in grasses cut for hay was 28,499. This represents an increase of 4,844 acres over acreage of 1889 and 2,675 over that of 1899. The hay crop consists of timothy and clover. Most of the crop is fed on the farm, although a part of it is sold in local markets. The leading varieties of clover grown here are the small red and sapling. Very little alsike is grown, though it is mixed with others by some farmers and is valued especially for its resistance to acid soil conditions. Some alfalfa is grown, most of it on the limestone soils. The hay is all consumed on the farm. Some crimson clover is also produced, largely in the orchard country, where it is used both as a green-manure and hay crop. Among the other legumes, soy beans and cowpeas are of some importance. The acreage of the former is the larger. The crops are utilized in the orchard sections for the same purposes as crimson clover. Experimental crops on Hagerstown clay loam have shown the soy bean to be more productive than cowpeas.

Dairying is an important industry in Washington County and is developing rapidly, especially on the limestone soils and in those sections convenient to shipping points. The Guernsey, Holstein and Jersey breeds are of relative importance in the order named. The dairy cattle are principally grades and crosses, although there are many herds of registered stock in the county.

Most of the milk and other dairy products are sold in Hagerstown. Some milk and cream is shipped to Washington, D. C.,. Desiccated-milk plants utilize considerable quantities of the milk produced in the county.

According to the census of 1910 the value of orchard products was \$360,592. The acreage in orchards has been greatly extended since this report was published. The peach orchards at that time contained 260,596 trees, and the crop of 1909 amounted to 117,895 bushels. Most of the fruit is packed and marketed fresh, but the five canneries and two evaporating plants located in the county consume a part of the crop. The leading varieties of peaches are the Carmen, Champion, Bell, Elberta, Smock, Solway, and Bilyeu.

Apples are the fruit of second importance. The census of 1910 gives the number of apple trees in 1909 as 141,113, with a production of 254,000 bushels. There has been a marked increase in the area of apple orchards since 1909. The apples are picked and marketed from shipping stations. Buyers visit the orchards and frequently attend to the picking. The product of some of the small orchards is sold to canneries and evaporating plants. The principal varieties of apples are York Imperial, Grimes, Stayman, Jonathan, Ben Davis, Baldwin,¹ Northwestern, and Rhode Island Greening. Orchards of more recent planting consist of Yellow Transparent, Oldenburg, Wealthy, Delicious, and Stark. Most of the apples are grown in the mountain sections of the western part of the county, and on the Berks, Clarksville, Hagerstown, and Upshur soils, which have proved well adapted to their production. Some peach orchards are located around Clear Spring, but apples predominate in all the western market sections, also being important around Boonsboro and Keedysville.

The grape does well in this part of Maryland but the fruit is not grown commercially. The census report of 1910 shows 11,999 vines in the county, with a production of 174,359 pounds. Concord, Niagara, and Catawba, with many other common varieties are found in the home vineyards.

Pears, plums, cherries, and quinces are not produced commercially at present, though indications point to an extension of the area devoted to these fruits.

Next to horticulture the feeding of live stock constitutes the most important industry. Many cattle are shipped into this county from the west. They are usually bought in Chicago and distributed from Greencastle, Pa. The steers are for the most part grades of various beef breeds, and are usually 2 years old. They are kept on the farms a year or more, and much of the corn and hay produced on the farms is converted into beef. The fattened cattle are sold locally or shipped to Baltimore or Chicago. Some are sold for export. According to the census report of 1910, there were 4,646 sold or slaughtered in

¹ Although south of the zone in which it does best this variety develops well in the vicinity of Hancock.

1909. The number of farmers engaged in this industry is considerable, and it would seem that there has been no decline in the annual output of animals since the last census.

Many hogs are raised in this section. The census report for 1910 shows that 27,025 were sold and slaughtered in 1909. Most farmers raise and fatten a few, but the number carried depends largely upon the price of corn. Berkshire, Duroc-Jersey, Ohio Improved Chester, and Poland-China are the leading breeds, stated in their order of importance.

The work stock of the county consists mainly of horses, many of them raised on the farms. The best stock is of Percheron or Belgian blood, the former predominating. Several fine imported Percheron sires are used and the character of the grades is high. Surplus stock is disposed of in the local markets.

Only four specialized truck farms are located in this county, although nearly every farm produces a little garden truck. Most of the commercial product is grown north of Hagerstown.

Rye is one of the minor crops of the area; according to the census report of 1910, the acreage was 1,354. The acreage is probably greater to-day. Some experimental crops of rye and vetch are reported, inoculation for vetch being necessary.

The adaptation of the soils of the county to the various crops seem to be well recognized. Fruits are grown mainly on the foothill or mountain soils and the general farm crops on the limestone soils of the valleys. Most of the peach orchards are on the Murrill gravelly loam, Dekalb gravelly loam, colluvial phase, and Dekalb gravelly loam. The most productive orchards are on the Murrill gravelly loam, which usually lies at higher elevations than the Hagerstown soils. The Dekalb gravelly loam, colluvial phase, has about the same range in elevation as the Murrill soils. The fruit on Dekalb soils matures slightly earlier than that on the Murrill. Along the west slopes of South Mountain, especially in the vicinity of Smithsburg, the peach is grown almost exclusively, the area in apples forming a very small portion of the fruit lands in this section. There is opportunity for more extensive development of peach growing all along the slopes of the mountains. The best apple soils are the Ashe gravelly loam, and the soils of the Berks, Clarksville, and Upshur series. The soils valued most highly for general farming are the Hagerstown silt loam and clay loam, the Porters silt loam and its shallow phase, and the Ashe silt loam.

Rotation of crops is general. The prevailing scheme provides for corn one year, wheat two years, and grass two years or more. Sometimes wheat is grown only one year, and after the second year in grass for hay the land may be pastured for indefinite periods.

In growing corn the land is plowed to a depth of 7 or 8 inches in March or April and harrowed and dragged until the seed bed is in good tilth. Planting is generally done with a two-row corn planter. The crop is check rowed, with rows 40 to 42 inches apart, and cultivated three or four times with a one-row walking cultivator or with a two-row riding cultivator. The crop is cut by hand and shocked, except where grown for silage when it is usually harvested with a corn binder.

Winter wheat is grown. When the crop follows corn, the stubble land is prepared by disking and the seed sown with 11-foot drills. When wheat follows wheat the land is ordinarily plowed. It is harvested with the binder, shocked, and sometimes stacked.

Timothy is usually seeded with the wheat and red clover the following spring is sown broadcast over the field. The hay is usually stored in barns, little of it being baled.

The farm buildings throughout the county are above the average. The houses are ordinarily of frame construction. Some, however, are built of brick or stone and are very substantial. Like the houses many of the barns are built of brick or stone and many are large, with a capacity sufficient to store all the hay and other crops and have ample room for the live stock and supplies. Silos are common throughout the dairy section of the county.

All kinds of improved farm machinery are used. There are five tractors in the area, while almost every farm has its binder, mower, hay tedder, various plows and harrows, disk roller, clod crusher, hay rake, and manure spreader, as well as fine wide-tired¹ wagons, which will hold between 40 and 50 flour barrels of corn. In the fruit sections the farms are also equipped with machinery for spraying.

According to the census report of 1910 there were 1,924 farms on which fertilizer was used, the total expense being \$126,773, or \$65.90 per farm reporting. Most of this fertilizer is applied to the wheat fields, the farmers depending largely on manure in growing corn. This is usually put on sod land the year preceding the corn crop. Mixtures analyzing 10 per cent of phosphoric acid and 2 per cent nitrogen, or of similar character, are used for wheat, the applications ranging from 200 to 400 pounds per acre. In normal times sodium nitrate is used in the peach orchards in amounts ranging from 200 to 300 pounds per acre. Liming is general throughout the county, and is especially desired in the valley. Hydrated lime is supplied by local plants in 50-pound bags. Burnt lime is applied in many cases, being produced on the farm where used. Lime marl is also commonly used. This is found throughout the valley region, and is said to be

¹ A double charge on toll roads for narrow-tired wagons has encouraged the use of broad tires.

of high grade, running from 70 per cent to 98 per cent calcium carbonate.

According to the census report of 1910, \$432,225 was expended for labor in 1909. Except during the harvest season, when much labor is brought in, the labor of the county is nearly all native born. The wages for a good farm hand by the month is from \$25 to \$35. Men employed in the harvesting of corn get 10 cents a shock, and a good man can earn as much as \$3.50 a day. In harvesting wheat, all day labor is paid \$3 a day. Peach and apple pickers ordinarily receive \$1.25 a day, and packers \$2.50 a day.

In 1910 the average size of the farms in Washington County was 93.8 acres, of which 77.8 acres or 83 per cent was improved. The holdings are generally larger in the hill country than in the valley.

The census gives the percentage of owner-operated farms as 66.2, nearly all the remainder being farmed by tenants. Farms are commonly rented on a share basis. Under the terms of the prevailing lease the owner pays taxes and buys half the fertilizer and receives half of all crops grown. The tenant supplies all live stock and machinery, agrees to return all manure and straw to the land, and to pay half the fertilizer cost.

Very little land is rented for cash. Cash rents vary from \$5 an acre up, depending on location, improvements, and kind and condition of the soil. Under this system the tendency is to produce more corn and wheat and to keep less live stock, with the result that the farms decline in productiveness. Under the share plan the owner retains more control over the operation of the farm.

The census of 1910 gives the average value of all farm property as \$7,513, of which 60.3 per cent represents the value of the land, 25 per cent the buildings, 11.1 per cent domestic animals, 3.6 per cent implements. The average assessed value of farm land is given as \$18.32 per acre.

SOILS.

On the basis of source of material, the soils of Washington County may be grouped into five broad general divisions. The most extensive and important division includes the soils of the Great Valley, which are derived largely from Shenandoah limestone. This is an extensive, massive bedded, blue and white limestone rock, which upon weathering gives rise to areas of the Hagerstown soils. The next important division includes the soils derived from sandstone, shale, and quartzite. These are confined to the Blue Ridge and the Appalachian Mountain sections of the county and to certain belts within the Shenandoah Valley. In many places the shale is varicolored and closely associated with sandstone. There is a strip of dark slaty shale extending across the county in a north-and-south

direction immediately west of Williamsport and Cearfoss. In the third division are the soils derived from igneous rocks, such as granite, gneiss, and other crystallines. The soils in this division, which differ considerably from those derived from limestone, shale, and sandstone, cover relatively unimportant areas. The rocks occur for the most part in the extreme southern and northeastern parts of the county. The fourth division includes soils of colluvial origin, formed from material moved by gravity down slopes and lodged on their lower parts. These soils are usually underlain by residual material from limestone and shale. The fifth division embraces those soils which are alluvial in origin, that is, consist of material deposited by the streams at times of overflow. These soils occur both in the flood plains and upon first and second terraces along the rivers and streams.

All the soils, with the exception of the alluvial and colluvial soils, are residual in origin, having been derived from material coming from the disintegration and decay of the underlying rocks. Since these rocks differ in their physical and chemical composition, the resultant soils differ widely in their physical and chemical properties. The soils having a common origin, color, structure, topographic position, and to some extent a related agricultural value, have been grouped into series. The series is again subdivided into types based upon texture, or the content of soil particles of different sizes.

The Hagerstown series is characterized by brown soils and reddish-brown or yellowish-brown subsoils. These soils are derived from limestone and occupy the greater part of the Great Valley. The Hagerstown silt loam, clay loam, clay loam, heavy phase, and stony loam are mapped in this area.

The soils in the Clarksville series have gray, yellowish-gray, or light-brown surface soils and pale-yellow friable subsoils. Only one type, the Clarksville gravelly loam, is mapped in Washington County. Soils of this series are derived from cherty limestone, fragments of which are commonly distributed over the surface and mixed with the soil and subsoil.

The Murrill series is represented by the gravelly loam type. This series is characterized by yellow or light-brown surface soils and yellowish-brown or reddish-brown subsoils. It consists of colluvial material which has been removed from its original place of formation and carried down slopes by landslides or more gradual creep and deposited over limestone soils.

The Dekalb series has yellow or light-brown surface soils and pale-yellow friable subsoils. These soils are derived from sandstone, shale or quartzite. The Dekalb stony loam, gravelly loam, gravelly loam, colluvial phase, and shale loam are typically developed in Washington County.

The Hanceville series differs from the Dekalb in that the surface soils are prevailingly brown and the subsoils are red or reddish-yellow. The Hanceville gravelly loam is the only member of the series occurring in the county. This soil is derived from sandstone, quartzite, or coarse textured shale.

The types included in the Berks series have yellowish-brown to light-brown surface soils and yellow to brownish-yellow subsoils. These soils are derived from shale and, in this county particularly, from the Martinsburg shale. The accumulation of soil from these rocks is generally shallow and outcrops of the rock are numerous. Small, thin, platy particles of shale are noticeable to a greater or less extent in all the types, though of course most numerous in the shale loam, while the gravelly loam carries angular fragments of shale and sandstone. The Berks shale loam, gravelly loam, and silt loam are mapped.

The Porters series is characterized by brown or reddish-brown surface soils, and red or reddish-brown subsoils. This series is derived from igneous rocks, such as granite and gneiss, or in some cases from sedimentary rocks. It is represented by the Porters silt loam and silt loam, shallow phase.

The Upshur series has reddish-brown or Indian-red surface soils and chocolate-red or Indian-red subsoils. These soils are derived from red sandstone and shale. Only one type of the series, the gravelly loam, occurs in Washington County.

The soils of the Ashe series are gray to light brown in the surface portion and yellow or brownish yellow in the subsoil. They are derived from granite and gneiss. The Ashe silt loam, stony loam, and gravelly loam are developed in the county.

The Frankstown series is characterized by yellow or brownish-yellow surface soils and yellow subsoils. These soils are derived from a shaly limestone or from interbedded limestone and shale. Only one type, the Frankstown silt loam, is mapped.

The Pope series has yellowish-brown to brown surface soils and yellow or light-brown subsoils. The soils of this series are derived from materials washed from sandstone and shale areas and deposited in the first bottoms of streams. Two types, the Pope silt loam and fine sandy loam, are mapped.

The types included in the Dunning series have dark-gray to black surface soils and gray or mottled gray and drab subsoils. This series represents limestone material which has been transported by the streams and deposited in their first bottoms, or material washed into depressions. Locally the subsoils are highly calcareous, but this is an exception and not typical of the Dunning as mapped in other areas. The silty clay loam type is the only member of the series in this county.

The Huntington soils are brown in the surface portion and have light-brown or yellowish-brown subsoils. These occur in the first bottoms of streams flowing through areas of Hagerstown soils, or represent material which has been transported to considerable distances under the limestone formation. The Huntington silt loam is the only type of the series encountered in this survey.

The Waynesboro series¹ is characterized by brown surface soils and red or reddish-brown subsoils. These soils are developed on second bottoms or terraces which have, in many places, been considerably eroded. They represent limestone material with an admixture of Appalachian material deposited when the stream flowed at much higher levels than at present. The Waynesboro gravelly sandy loam and a heavy phase of this type are separated upon the soil map.

The Holston series has brown surface soils and yellow to brownish-yellow subsoils. These soils occur on the second bottoms or high terraces. The materials come largely from sandstone, and shale. The Holston silt loam is mapped.

The Elk series includes types with brown surface soils and light-brown or light yellowish brown subsoils. It represents alluvial material washed from the limestone soils. It occupies second bottoms or terraces along the larger streams. Only one type, the silt loam, is mapped.

Rough stony land represents those rough, steep, broken, and usually mountainous areas which have an abundance of large stone on the surface or are marked by numerous outcrops of rock. The topography, together with the excess of rock render the areas non-agricultural.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Hagerstown silt loam.....	97,984	33.4	Rough stony land.....	4,224	1.4
Hagerstown clay loam.....	29,632	10.9	Ashe silt loam.....	4,032	1.4
Heavy phase.....	2,496		Ashe stony loam.....	3,712	1.3
Dekalb gravelly loam.....	17,152	8.9	Holston silt loam.....	3,456	1.2
Colluvial phase.....	9,152		Huntington silt loam.....	3,136	1.1
Berks shale loam.....	24,320	8.3	Pope silt loam.....	3,136	1.1
Murrill gravelly loam.....	19,776	6.7	Hanceville gravelly loam.....	3,008	1.0
Dekalb stony loam.....	13,376	4.6	Dekalb shale loam.....	2,914	1.0
Frankstown silt loam.....	8,512	2.9	Porters silt loam.....	1,920	0.8
Upshur gravelly loam.....	7,168	2.4	Shallow phase.....	320	
Berks silt loam.....	6,016	2.0	Pope fine sandy loam.....	1,920	0.7
Waynesboro gravelly sandy loam..	4,736	2.0	Hagerstown stony loam.....	1,728	0.6
Heavy phase.....	1,280		Clarksville gravelly loam.....	1,088	0.4
Berks gravelly loam.....	5,952	2.0	Dunning silty clay loam.....	1,024	0.3
Elk silt loam.....	5,376	1.8			
Ashe gravelly loam.....	5,184	1.8		293,760

¹ Not to be confused with the Waynesboro geological formation, to which the soils bear no relation.

HAGERSTOWN STONY LOAM.

The Hagerstown stony loam includes areas of abundant limestone outcrops. The soil between the rocks is of silt or clay loam texture and similar to the Hagerstown soils of like texture.

The Hagerstown stony loam occupies the rougher and more hilly parts of the limestone valleys. It also forms areas along water courses and on steep slopes where erosion has removed all or a part of the soil. One of the larger areas of this type occurs south of Funkstown.

Some of the areas are forested with a mixed growth of hardwoods, including oak, hickory, locust, and cherry. Aside from its use as pasture, for which it is well adapted, the type has little agricultural value. The loose stones and ledge rock make plowing impracticable.

Lands of this type are usually included in farms composed mainly of Hagerstown silt loam and Hagerstown clay, and are rarely sold alone.

HAGERSTOWN SILT LOAM.

The surface soil of the Hagerstown silt loam is a brown silt loam, 6 to 15 inches deep. The subsoil is a yellowish-brown to reddish-brown moderately friable clay, usually becoming more compact and stiffer with increase in depth. In places, the upper subsoil is brownish yellow, but the color soon changes to yellowish red.

Patches of Hagerstown clay loam, and, more rarely, of Hagerstown clay are included with this type, as mapped. These represent areas developed from intermediate or deeper substratum of material exposed by erosion.

Fragments of limestone and quartz and in some places of sandstone, shale, and quartzite occur on the surface of areas contiguous to the Murrill gravelly loam, but the proportion of gravel is nowhere sufficient to interfere with cultivation. Many ledges of limestone outcrop throughout the areas of this type. Most of them were indicated on the map by symbol, but many were obscured by growing crops. Where the condition existed in areas large enough, the soil was mapped as Hagerstown stony loam. Most of the land is worked close to the ledges. The soil section becomes more and more shallow as they are approached.

In addition to the variations in type already noted, there are certain areas that have been influenced by colluvial action. The soil here consists of a brown mellow silt loam 12 to 15 inches deep, underlain by a light-brown to yellowish-brown silt loam which passes at a depth of 20 to 24 inches into yellowish-brown silty clay, in places overlying yellowish-red clay. Areas of this kind are developed in a

low flat about one-half mile south of Funkstown on the State road. Another small area lies west of Fiddlesburg, another in the valley east of Marsh Church, and another north and east of Maugansville. Similar developments were noted north of Smoketown School, and 1 mile southwest of Center Hill School, west of the pike. Smaller spots occur throughout the Hagerstown silt loam area.

The Hagerstown silt loam is the most extensive soil in the county, forming one-third its area. It occupies the central part of the county, the largest belt lying in the valley between Conococheague Creek and South Mountain. The areas, however, are not continuous, but are interrupted by other limestone soils as well as by alluvial bottoms. Large unbroken tracts occur north, east, and west of Hagerstown.

The topography of this type is flat to gently rolling, the surface features in general being favorable to the use of improved farm machinery of all kinds. The character of the surface also in general gives good drainage. The conditions in the lime sinks, many of which occur throughout the area, are not so good as on the rest of the soil, while some of the colluvial areas are subject to the occasional accumulation of seepage water.

The Hagerstown silt loam is the most important soil in the county, and with the exception of some scattered woodlots, covered with hardwood forest, it is practically all under cultivation. It is used chiefly for the production of general farm crops and dairying is carried on to a considerable extent, especially in the vicinity of Hagerstown and other towns, and along the various railroads. The general crops are corn, wheat, and hay. A small quantity of oats is produced, the crop usually being sown on strips of corn land occupied by corn shocks when the fields were seeded to wheat.

Crops are rotated according to the plan outlined in the chapter on agriculture. The yields of corn range from 50 to 100 bushels, of wheat 20 to 40 bushels, hay 1 to 2 tons, and oats between 30 and 40 bushels per acre.

The chief means used to maintain the productiveness of the soil consist of heavy applications of stable manure and the regular use of lime, which in many cases is burned on the farm.

Lands of this type sell for \$200 to \$600 an acre, depending on location and improvements.

The Hagerstown silt loam is exceptionally well farmed. There seems to be a gradual tendency toward the dairy industry and many farms are being equipped with silos. It is an excellent type for all kinds of forage crops and grass, and therefore a valuable soil on which to engage in dairying.

HAGERSTOWN CLAY LOAM.

The Hagerstown clay loam consists of a reddish-brown or brownish-red clay loam or silty clay loam, underlain at 5 to 8 inches by a dull-red clay or yellowish-red clay passing into dull-red clay, of moderately stiff and firm but not plastic structure.

The depth of the soil and subsoil of this type is quite variable, and usually less than that of the Hagerstown silt loam, and rarely more than 3 feet. Outcropping limestone ledges are more or less numerous and where abundant are indicated on the map by rock outcrop symbols or, if of sufficient area, mapped as Hagerstown stony loam. As the more rocky areas are approached the soil material becomes shallower. Included with this type are patches of Hagerstown silt loam, Hagerstown clay and, more rarely, Hagerstown sandy loam and Murrill gravelly loam, all of which would have been separated and mapped had the areas been large enough. Probably the most important variation of this type consists of gravelly areas, which are shown on the map with gravel symbols. This is a reddish-brown clay loam or brownish silt loam, or silt passing quickly into reddish clay loam, underlain at about 6 to 8 inches by reddish-brown to dull-red clay, containing, some partially decomposed rock, apparently from the parent limestone. Over the surface and throughout the soil section are fragments of angular chert and bluish limestone. Outcropping ledges of limestone also occur.

Areas of this character are confined to the east slope of Tonoloway Ridge. At present they are being utilized principally for the growing of apples and peaches, and although the soil is relatively shallow, they seem to be well adapted for this purpose.

There is also included with the Hagerstown clay loam in the section west of Woburn School and near the river a sandy variation, in which the soil and subsoil have a deeper red color, and are covered with a shallow layer of sand. A few small spots of material similar in some respects to the Colbert clay or clay loam were noted three-fourths mile northwest of St. Pauls Church and near the Pennsylvania line northwest of Fairview.

The Hagerstown clay loam is not as widely distributed in Washington County as the Hagerstown silt loam, with which it is closely associated. It is well developed along Antietam and Little Antietam Creeks, and also in the country drained by Beaver Creek. It occupies slopes and tops of low hills and ridges in the gently rolling valley country. It is well drained in general, and in local places on the steeper slopes drainage may be excessive.

Fully 90 per cent of this type is under cultivation, the remainder being taken up by woodlots or small areas of forest, consisting of

oak, hickory, and other hardwoods. The type is used for the production of corn, wheat, and hay, under the rotation plan already outlined. The yield of corn ranges from 35 to 80 bushels, of wheat from 20 to 50 bushels, and of hay from 1 to 1½ tons per acre.

Stable or lot manure when available is the chief fertilizer used. It is applied to sod land preceding corn or as a top dressing to grass the year succeeding corn. Wheat is usually fertilized with 200 to 400 pounds of a mixture analyzing 10 per cent phosphoric acid and 2 per cent nitrogen. Nearly all the tests made indicate that this type is generally acid, and lime is ordinarily applied at regular intervals, usually in the burnt form. Comparatively little crushed limestone but considerable marl is used, deposits of which are found in stream valleys near this type. The rate of application of burnt lime is 500 to 1,000 pounds, and of crushed limestone or marl from 1,000 to 2,000 pounds per acre. Hydrated lime from local plants is also used to a considerable extent. This is put up in convenient 50-pound sacks and applied in amounts ranging from 1 to 2 tons per acre. The use of lime has been found beneficial both in improving the physical condition of the soil and in neutralizing acidity.

Lands of this type are valued at \$100 to \$500 an acre depending on location and improvements.

The Hagerstown clay loam is one of the strongest soils in the county for general farm crops. It is, however, somewhat difficult to handle, the soil scouring poorly unless in just the right moisture condition. It also clods badly if plowed when dry. Deep plowing, the incorporation of organic matter, and the more frequent use of lime will do much to overcome these difficulties and tend to maintain and increase the productiveness of the soil.

Hagerstown clay loam, heavy phase.—The soil of the Hagerstown clay loam, heavy phase, is a brownish-red or dark-red clay, usually somewhat loamy, about 6 inches deep. The subsoil is a red or dark-red, stiff, heavy clay which extends to the underlying parent limestone, rarely lying more than 3 feet below the surface and in many places outcropping.

The areas of this heavy phase represent Hagerstown silt loam and clay loam areas from which the surface soil has been removed by erosion and the heavier underlying material exposed. The soil is inextensive and confined to the central part of the county. A well-developed area lies about three-fourths mile south of Keedysville, another 1½ miles west of Downsville, and others northwest of Smoke-town and south and southeast of Benevola.

Areas of this phase occupy valley slopes and the tops of low ridges. Their surface is gently rolling and favorable for the cultivation and harvesting of crops with machinery. Drainage is good to excessive.

The Hagerstown clay loam, heavy phase, is a rather difficult soil to work, and this is probably the main reason why so little of it is used for cultivated crops. If too wet when plowed it does not scour, and if too dry it turns up in clods. The greater part of the heavy phase is used for mowing and pasture lands, although some excellent crops of corn and wheat were seen on it during the survey.

Land of this kind is held at \$80 to \$200 an acre depending on location, improvements, and conditions of the soil.

The more frequent use of lime and the incorporating of organic matter would do much to improve the physical condition of this heavy soil.

CLARKSVILLE GRAVELLY LOAM.

The Clarksville gravelly loam consists of a gray, grayish-brown, or brown cherty loam or silt loam about 10 inches deep, grading into a yellow or grayish-yellow silty cherty clay which usually extends to a depth of 36 inches. The chert occurs in small angular fragments of gray or light-gray color, abundantly scattered over the surface and mixed with the soil and subsoil. Outcrops of the rock from which these fragments come are found throughout the type.

The Clarksville gravelly loam is inextensive in the present survey. It is well developed on the east and west slope of Tonoloway Ridge and, not so typically, on the crest of the ridge east and southeast of Indian Springs. The topography is variable. In places it is flat, in others it is rolling, and in others steep and rough. Drainage is good and locally excessive. In general the moisture supply is sufficient to enable crops to withstand severe droughts. This is probably due, in some measure, to the mulching effect of the cherty fragments which cover much of the surface.

Owing to its small extent the Clarksville gravelly loam is a type of relatively little importance in the agriculture of the county. It is nevertheless highly esteemed locally, being considered one of the stronger and more productive soils of the mountain sections. Notwithstanding its gravelly nature, which interferes with cultivation somewhat, the soil is not a hard type to handle, and probably 60 per cent of it is under cultivation. The rest supports a mixed forest of oak, chestnut, and poplar.

The Clarksville gravelly loam is used for the production of fruit, corn, grain, and grass. Some of the finest apples and peaches grown in this area, both as regards color and shipping quality, are produced on this type. The yield of corn ranges from 40 to 60 bushels; wheat, 15 to 40 bushels; and hay, about 1 ton per acre.

Land of this type is held at \$35 to \$150 an acre, depending on location, improvements, condition of the soil, and topography.

It would seem that fruit growing could be profitably extended on this type, as it is well adapted to this purpose, while it can not

be used as satisfactorily for cultivated crops, as the smoother, stone-free lands of the valley areas.

MURRILL GRAVELLY LOAM.

The soil of the Murrill gravelly loam consists of a yellowish-brown or brown loam from 8 to 12 inches deep. The subsoil is a yellow or yellowish-brown silty clay, which, at depths varying from 15 to 30 inches, is underlain by red or reddish-brown silty clay, extending usually to a depth of 3 feet or more. Over the surface and throughout the soil material, especially above the red clay stratum, large and small angular sandstone, quartzite, and, less commonly, limestone and shale fragments occur.

Included with the type as mapped are a few patches of Murrill gravelly sandy loam, Murrill silt loam, and, more rarely, Hagerstown clay loam. All these, however, were too small to show on the map. The Murrill gravelly sandy loam is found on steeper slopes, especially north of Boonsboro and south of Little Beaver Creek, and the Murrill silt loam lies in the more level or flat areas. The patches of Hagerstown clay loam were most plentiful around Smithsburg and in the vicinity of Clear Spring.

The Murrill gravelly loam is a colluvial soil which has been spread over the residual products of limestone. The material has been derived from quartzite, sandstone, and shale of the higher mountain slopes moved to its present position on the lower slopes by landslides and slower creep and wash. The depth of the deposit over the limestone material varies considerably, but the latter is seen in nearly every road cut. The unweathered limestone, however, is rarely uncovered.

The Murrill gravelly loam is extensively developed in Washington County. Areas are mapped along both the eastern and western sides of the Great Valley, on the lower slopes of Fairview and South Mountains. The areas extend somewhat into the valley, but always lie at higher elevation than the limestone soils. The areas are uniformly near the mountains, and the type is well developed in the vicinity of Smithsburg, to the east of Beaver Creek, and west of South Mountain to Boonsboro and toward Locust Grove. A detached area occurs west of Elk Ridge and others in and around Clear Spring. As developed on the east side of Tonoloway Ridge, the soil is not typical, being less uniform in color, texture, and depth. The Murrill gravelly loam has a gently rolling topography. The type is generally well drained, with local spots where the drainage is excessive, but on the whole crops withstand long periods of drought better than on the valley soils, owing probably to the abundant gravel on the surface which tends to retard evaporation. It is a type that warms up early

and crops mature early on it. The quantity of gravel is sufficient to interfere with cultivation somewhat, and the wear and tear on implements is a factor to be considered in comparing this soil with the stone-free soils of the county.

The Murrill gravelly loam is utilized in the production of fruit or general farm crops. Fruit growing, especially peaches, is the leading interest. Peach trees on this type are said to be more prolific than on any other soil in the county. The principal varieties grown are Carmen, Champion, Bell, and Elberta. The Solvay and Bilyeu, favorite varieties around Smithsburg, also are said to thrive on this type. Among the apples grown the Ben Davis and York Imperial lead; the former is said to do unusually well on this type. Small quantities of grapes, mostly Concord, Niagara, and Columbus, also are produced.

The general farm crops are wheat, corn, and hay. The reported yields of corn range from 15 to 40 bushels, wheat 15 to 30 bushels, and hay about 1 ton per acre. The rotation followed on the Hagerstown soils is practiced on this soil.

In addition to the crops enumerated, some crimson clover, and soy beans are grown as renovating crops. These are generally plowed under, but in some cases may be grazed down before plowing. Land of this type is held at prices ranging from \$75 to \$150 an acre.

DEKALB STONY LOAM.

The soil of the Dekalb stony loam consists of a light-brown or brownish-gray loam to silt loam, from 1 to 8 inches deep, underlain by a pale-yellow or yellow silty clay loam or loam, rarely exceeding a depth of 24 inches, both carrying large sandstone and quartzite stones and an abundance of small platy shale and sandstone fragments.

Included with this type are local spots of Dekalb stony sandy loam and Dekalb stony silt loam, both of which would have been mapped separately had their extent warranted. The former occur at or near the crests of South Mountain and other mountains, particularly Pine Knob, while the latter is locally developed about 1 mile west of Clear Spring.

The Dekalb stony loam is not an important type agriculturally, though extensive and widely distributed throughout the mountain section of the county. It is typically developed in the areas on the summits and slopes of Sideling Hill Mountain and Tonoloway Ridge. More extensive areas occur on Bear Pond Mountain, Powell, Sword, Rickard, and Fairview Mountains, also on Elk Ridge and South Mountain, especially from Buzzard Knob to Fox's Gap, and near Weverton.

Practically none of this type can be utilized for agriculture, occupying as it does steep and rough mountain areas, with an abundance of loose surface rock. Most of this type is forested with chestnut, chestnut oak, red oak, and maple, with some pine and black gum. Although generally adapted only to a forest growth, some of the better areas, if the stones were removed, could probably be used for fruit growing.

DEKALB SHALE LOAM.

The surface soil of the Dekalb shale loam consists of a layer of gray to light-brown silt loam, 2 or 3 inches thick, passing into a pale-yellow silt loam which extends to 6 or 8 inches. The soil grades into a pale-yellow silty clay loam or friable or rather stiff silty clay subsoil, which rarely extends to a depth of more than 2 feet below the surface, where it is underlain by partially decomposed and disintegrated shale. In a few places the subsoil is streaked with red or yellowish red. Distributed over the surface and mixed with the fine earth of both soil and subsoil there is a large quantity of small angular shale chips. In many places the fragments are larger and more abundant in the subsoil.

In the extreme southern part of the county there are a few areas of silt loam, occurring in close association with the shale loam, which differ from the latter in that the soil is practically free from shale chips or gravel.

Dekalb shale loam is one of the inextensive and unimportant types of the county. Its principal development is in the vicinity of Dargan. For the most part the areas lie on gently inclined to steep valley slopes. All of it is well drained. In places erosion has removed the soil material exposing the parent shale rock. In fact, the formation of the type in all probability has been due in part to the active erosion on these slopes, which has removed the greater portion of the finer soil material as it is formed.

A considerable part of this type is under cultivation. It is used for the production of apples and peaches, and the general farm crops. Corn is the principal crop, and does moderately well, yielding from 10 to 30 bushels per acre. Wheat yields 10 to 20 bushels, and timothy and clover, one-half to three-fourths tons of hay per acre.

Deep plowing and the incorporation of organic matter would do much to increase the productiveness of this type. It would also tend to decrease erosion, which is one of the problems of cultivation on soil so subject to washing as this. Owing to its position the soil seems better suited to the production of fruit or to use as pasture than for general farming.

DEKALB GRAVELLY LOAM.

The soil of the Dekalb gravelly loam consists of a grayish-brown or light-brown loam, 6 to 10 inches deep. The subsoil is a friable light silty clay or silty clay loam of a yellow or pale-yellow color, usually extending to a depth of 3 feet or more. Over the surface and throughout the soil section is an abundance of small and large angular gravel, most of it platy in character, consisting of fine-grained sandstone, quartzite, and shale.

In places the gravel content is relatively low; in others the fragments occur in such large quantities as seriously to interfere with cultivation. The spots of low gravel content would have been mapped separately had their extent warranted it. They lie east of Black Rock on the crest of the ridge and represent isolated developments of the Dekalb loam. The areas excessively stony, had their separation been practicable, would probably be more consistently classed with the Dekalb stony loam.

Some areas of Dekalb gravelly fine sandy loam are also included with the Dekalb gravelly loam on the ridge tops 1 mile south of Quirauk Mountain and on some ridges southeast of Edgemont. Areas of similar soil also occur northeast of Pondsville and southeast of Jugtown. The gravel particles in such areas average smaller than in the gravelly loam type.

The Dekalb gravelly loam is important in extent, but of comparatively little importance as far as agricultural occupation is concerned.

The Dekalb gravelly loam occupies the tops of low ridges on the upper slopes of the higher mountains. It occurs principally in the eastern part of the county, on the west slopes of South Mountain from Pen Mar to Monument Knob and beyond. A detached area lies on Elk Ridge, and there is a considerable area of this soil around Dargan. A few small areas occur in the western part of the county; one of these is on the crest of Pigskin Ridge, two along Tonoloway Creek, and a small area, less typical, on Cove Ridge north of Hancock, in which the texture is more nearly a gravelly fine sandy loam than a loam. In general the drainage is good to excessive.

Probably not over 20 per cent of the type is farmed. The rest of it supports a mixed forest of red oak, white oak, chestnut, locust, pine, dogwood, poplar, and maple.

Where cultivated the Dekalb gravelly loam is used for the production of fruit and general farm crops. Peaches, apples, cherries, and grapes, are grown, but the peach production is by far the most important interest. The fruit matures earlier on this type than on any other soil in the county. The general farm crops are corn, wheat, and grass. The yield of corn ranges from 10 to 15 bushels, wheat 8 to 15 bushels, and hay one-half to three-fourths ton per acre. The type is more productive for fruit than for general farm crops.

Lands of this type of soil range in price from \$15 to \$75 an acre.

The organic content of this type is low and should be materially increased. The success on this type with fruit would seem to indicate that the industry could be extended profitably.

Dekalb gravelly loam, colluvial phase.—The soil of the Dekalb gravelly loam, colluvial phase, consists of a grayish-brown or light-brown loam, 6 to 12 inches deep, resting upon a pale-yellow or medium yellow clay subsoil, which extends to a depth of 3 feet or more. Scattered over the surface and mixed with the soil and subsoil are numerous fragments of angular sandstone, quartzite and shale rock, the proportion of such coarse material becoming larger with depth.

This type represents material derived from the higher lying and steeper lying Dekalb areas through the action of slides, soil creep, and surface wash. The areas occupy the lower slopes or foothills of the more conspicuous mountains.

This phase of the Dekalb gravelly loam is not extensive, though one of the more important mountain soils. It is well developed in places on the east and west slopes of Sideling Hill, on the west slope of Elk Ridge, and in a larger and more continuous area in the foothills of South Mountain. It occurs also east and northeast of Smithsburg, north and south of Bagtown, west of Fox's Gap, and in detached areas to the east of Boonsboro.

This is in general a better soil than the typical Dekalb gravelly loam, and nearly as productive as the Murrill gravelly loam. Probably 40 per cent of the phase is under cultivation, the rest supporting a mixed forest of red oak, white oak, and chestnut, with some dogwood and pine. Fruit and general farm crops are produced. The greater proportion of the fruit is grown in the more eastern areas of the type. Peaches are the most important fruit crop, though apples are grown extensively. Cherries and grapes thrive, but the growing of these or other small fruits has not been developed on a commercial scale. The general farm crops are corn, wheat, and hay. The yields of corn reported range from 15 to 30 bushels, of wheat from 10 to 20 bushels, and of hay one-half to 1 ton per acre. In the orchard section some soy beans, cowpeas, and crimson clover are produced.

It is an excellent type for the production of fruit, and it would seem that the industry could be profitably extended to areas now used for other crops. Lands of this type are sold at prices that range from \$20 to \$125 an acre.

Organic content is generally low, and this should be increased by turning under stable manure and green manures, preferably using leguminous crops for this purpose. Cowpeas, soy beans, and crimson clover can all be used to advantage on the type in Washington County.

HANCEVILLE GRAVELLY LOAM.

The surface soil of this type is a light-brown, yellowish-brown, or dark-brown fine sandy loam having a depth of 8 to 12 inches. The subsoil is a red, yellowish-red, or reddish-yellow friable sandy clay which usually extends to a depth of 3 feet or more. Both soil and subsoil contain a large proportion of angular fragments of sandstone, quartzite, and, to a much less extent, shale. About 1 mile west of Huyett, on the tops of the ridges near Conococheague Creek, and also in spots throughout the Berks shale loam near the Potomac River there occur small areas of a brown or grayish-brown silt loam, underlain by a red or yellowish-red friable clay or silty clay, the soil and subsoil containing few shale fragments but not in sufficient quantities to make a true gravelly type. Included with this type also are spots of Dekalb gravelly loam and stony loam too small to be separated on a map of the scale used in this survey.

The Hanceville gravelly loam has a restricted development in the county. It occurs principally in the western part, and the largest areas occur north of Indian Springs. Smaller bodies in the eastern part of the county lie southwest of Greenbrier, east of Smoketown, and west of Mount Brior. There are also several small bodies west, northwest, and southwest of Fox's Gap.

This soil is found both on the lower and upper slopes of the mountains and also to a limited extent on the top of the low ridges. Its surface is, therefore, gently rolling to strongly rolling and mountainous. All of it is well drained and much of it is subject to erosion.

Nearly all the type is under cultivation. It is used for the production of corn, wheat, and hay. Corn yields from 15 to 35 bushels, wheat 10 to 20 bushels, and hay from one-half to 1 ton per acre. A few small orchards of peaches were seen on this type. The trees were in a healthy condition.

Land of this type is held at \$35 to \$100 an acre.

The steeper and more rolling portions of the Hanceville gravelly loam should be seeded to grass and used for pasture. The soil would seem to be well adapted to the production of peaches and apples, but in selecting sites for commercial orchards, only land smooth enough to allow the use of spraying and other machinery should be considered.

BERKS SHALE LOAM.

The Berks shale loam represents areas of Berks silt loam from which most of the soil has been removed by surface wash and erosion. The soil is a brown silt loam 8 to 10 inches deep. The subsoil, which rarely exceeds a depth of 20 inches, consists of a yellow or yellowish-brown silty clay loam. In many areas the underlying shale outcrops or lies immediately below the surface soil. Over the surface and mixed with the finer soil and subsoil material there occur large quan-

tities of shale chips, the fragments becoming larger and the proportion greater with depth. The fragments are, however, small and rarely interfere with cultivation.

Included with the typical Berks soil, in the western part of the county especially, are some materials from limestone and finely laminated shaly limestone which are so closely associated with the typical shale that no separation could be made. The derived soils would have been included with the Frankstown series had separation been practicable.

The Berks shale loam is an important type as regards extent, but unimportant as regards agricultural development. It is confined largely to the western half of the county, an important belt lying west of Huyett between the Pennsylvania line and the Potomac River, bordering the Conococheague Creek. This belt is broken by a few small areas of Berks silt loam. A small area lies near St. Pauls Church and another to the northeast of that place. Other areas lie around McCoys Ferry, west and east of Licking Creek, east, north, and west of Hancock, and along the base of Tonoloway Ridge from the river to the State line. It also is well developed on the slopes of Sideling Hill near the Pennsylvania line.

The Berks shale loam occupies generally smooth and frequently steep slopes, occurring mainly on their lower parts. It borders most of the stream valleys in the western part of the area. The type is thoroughly and in many places excessively drained.

Probably not over 20 per cent of this type is under cultivation, the rest of it supporting a mixed forest growth of oak, hickory, chestnut, and occasionally pine. The part farmed is used for the production of the general farm crops, corn, wheat, and hay. The yields are moderate, corn returning from 15 to 30 bushels, wheat 8 to 20 bushels, and hay from one-half to 1 ton per acre.

The Berks shale loam is easy to work, and all crops mature quickly. The land is inclined to be droughty, and unless there is an abundance of rainfall the yields are likely to be low.

Land of this type can be purchased for \$20 to \$125 an acre.

Deep plowing and the incorporation of organic matter would do much to increase the water-holding capacity of the type and in this way alone improve the productiveness. Much of the type, especially on the steeper slopes, should be kept in permanent pastures or allowed to reforest. A few orchards situated on the type appear to be in a thrifty condition, and probably suitable areas could be used in an extension of the industry. It is not, however, a type that can in general compete with some other mountain soils in the economic production of crops, either fruits or field crops, as there are but few places where improved machinery can be used, and this is an essential factor in modern orcharding in particular.

BERKS GRAVELLY LOAM.

The soil of the Berks gravelly loam consists of a yellowish-brown or brown loam or silt loam from 6 to 12 inches deep, carrying large quantities of small grayish sandstone and quartzite fragments. The subsoil consists of a yellowish-brown or yellow silty clay loam or silty clay, which extends to bedrock, almost always lying within 3 feet of the surface and usually at depths between 20 to 36 inches. The subsoil also contains sandstone and quartzite fragments.

Areas of this type are confined to the western part of the county, although a few spots occur west and southwest of Fox's Gap. It is not an extensive soil. It is well developed on the crest of Coon Ridge and on the southern part of Pigskin Ridge and occurs south of the State road north of Roundtop. There are also a few detached areas along Sideling Hill Creek, a large area extends from the Potomac River to the State line west of Elbow Ridge, and other small areas scattered over the western part of the county.

The topography is gently rolling to sloping, and the drainage is consequently good. Most of the type is farmed, and it has about the same agricultural value as the silt loam of the series, crops probably doing a little better during dry spells, owing in part to the surface mulch of gravel. It is not so well improved as the Berks silt loam and has not been as well cared for, and this is reflected in crop yields. The leading crops are corn, wheat, and hay. The yield of corn reported ranges from 15 to 30 bushels, wheat 10 to 20 bushels, and hay one-half of 1 ton per acre.

Land of this type is held at \$20 to \$75 an acre.

The more frequent use of lime, the incorporation of organic matter, deeper plowing, and more thorough tillage would do much to increase the productiveness of this type.

BERKS SILT LOAM.

The soil of the Berks silt loam consists of a brown mellow silt loam, 6 to 12 inches deep. This grades gradually into a yellow silty clay at depths ranging from 14 to 18 inches through a transition zone of yellow or yellowish-brown silt loam or light silty clay. The total depth of the soil material over the rock rarely exceeds 3 feet. Some small shale chips lie on the surface and the soil and subsoil contain similar loose material, the proportion being greater in the lower part.

Included with this soil as mapped are some small areas of poorly developed Hanceville silt loam, which differ from the Berks soil in having the deeper subsoil spotted or streaked with red, reddish yellow, or yellowish red. Such areas would have been mapped separately had their size justified it. Another variation was noted near the

Pennsylvania line where in certain areas a scattering of well-rounded gravel occurs on the surface. These areas represent the remnants of an old terrace, and are not mapped as a distinct type solely because they are so small. The Berks silt loam is one of the unimportant soils of the county as regards distribution, but is considered a valuable agricultural type. It is only developed in the western part of the county, particularly on the ridge tops near Conococheague Creek.

This type occupies rounded hills and ridges and might be described as gently rolling highlands. Drainage is everywhere thorough, and in areas where the underlying shale lies near the surface excessive.

This soil is easy to work, and crops generally can be produced economically, as all kinds of labor-saving machinery can be utilized in their cultivation. Corn, wheat, and hay are the principal crops. The yield of corn ranges from 20 to 50 bushels, wheat 15 to 25 bushels, and hay about 1 ton per acre.

Lime and phosphatic fertilizers are said to give good results on this type. It does not withstand prolonged periods of drought, however, as well as the Hagerstown silt loam, and every means should be used to increase the power of the soil to hold water.

PORTERS SILT LOAM.

As typically developed the Porters silt loam consists of a reddish-brown or brown silt loam from 6 to 12 inches deep, underlain by a yellowish-red or reddish-yellow or brownish-red light silty clay which becomes heavier and mottled with yellow and brown with increase in depth. The soil material rarely exceeds a depth of 3 feet and not infrequently the parent greenstone comes to the surface.

Included with this type are local areas of soil somewhat similar to the Talladega silt loam. This soil seems to be derived from mica schists and other altered rocks that occur along the contact between the igneous and sedimentary formations, particularly in the vicinity of South Mountain. It, however, is so closely associated with the Porters silt loam and its extent is so small that no separation can be made. Also included with the Porters silt loam, but shown on the accompanying map with gravel symbols, is some Porters gravelly loam. This is practically the same material as the silt loam with the addition of conspicuous amounts of angular greenstone, sandstone, and quartzite gravel. Where it occurs in the valley section the gravel is generally colluvial from higher lying Dekalb areas. On the South Mountain the gravel is the same as the underlying rocks.

The Porters gravelly loam is inextensive. It is closely associated with the Ashe silt loam and Ashe gravelly loam. A few well developed areas occur on the crest of South Mountain near the Frederick County line and others in the valley of Israel Creek. The silt

loam is also of small extent, being confined to the same valley between Rohrersville and the Potomac River. It occupies a relatively low position. The topography is in general gently rolling and the drainage good to excessive, and accompanied by more or less active erosion, which in places has exposed the silty clay or clay subsoil.

Probably 80 per cent of the Porters silt loam is under cultivation, the rest supports a mixed growth of poplar, oak, hickory, walnut, maple, and other hardwoods. The cultivated area of this soil is used for the production of corn, wheat, and hay. The yield of corn ranges from 20 to 40 bushels, wheat from 12 to 30 bushels, and hay from 1 to $1\frac{1}{2}$ tons per acre.

The soil is easy to work and crops mature early on it. The surface is favorable to the use of all kinds of labor-saving machinery and crops can therefore be produced more economically than on the more rolling mountain types.

The price of land of this type ranges from \$80 to \$150 an acre.

Deep plowing, the maintenance of the supply of organic matter, and the use of lime are practices that have proved profitable on the better managed farms on this soil, and they should be adopted wherever the type is brought under cultivation.

Porters silt loam, shallow phase.—The soil of the Porters silt loam, shallow phase, consists of a reddish-brown or brownish-red clay loam, between 6 and 10 inches deep. The subsoil is a red, to reddish-yellow brittle clay which seldom attains depths greater than 24 inches. Below this layer lies a greenish igneous rock from which the type is derived, and fragments of the rock are scattered over the surface, though not in sufficient quantities to make the soil gravelly loam.

Only a little of the shallow phase is developed in Washington County. Representative areas occur in the vicinity of Rohrersville, near the headwaters of Little Antietam Creek. It has been formed through the removal of the surface soil from areas originally Porters silt loam. The topography is gently rolling.

Practically all the Porters silt loam, shallow phase, is under cultivation. It is used for the same crops as the Porters silt loam and does not differ greatly from the latter in productiveness. It brings about the same price as this type.

Means to prevent erosion, among which may be mentioned deep plowing and the incorporation of organic matter, should be employed generally in cultivating this soil. Such practice will also tend to make the soil retentive of moisture and thus increase the yield of crops, especially of corn, in the production of which moisture supply is nearly everywhere the controlling factor.

The following table gives the results of mechanical analyses of the soil and subsoil of the typical Porters silt loam:

Mechanical analyses of Porters silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
201348.....	Soil.....	2.1	3.4	1.6	5.8	8.4	55.7	23.2
201349.....	Subsoil.....	9	2.4	1.2	4.3	7.4	34.5	49.4

UPSHUR GRAVELLY LOAM.

As typically developed the soil of the Upshur gravelly loam consists of a light chocolate brown to reddish-brown loam or fine sandy loam from 6 to 10 inches deep. The subsoil is a reddish-brown or Indian-red light clay loam which rarely exceeds a depth of 20 inches, and in many places rests on the red shale or fine-grained sandstone at depths much less than this. Fragments of red shale or fine fragments of sandstone are abundant on the surface and through the soil mass, but do not generally interfere with cultivation. In places the rocks from which these are derived outcrop.

Included with the typical material is some Upshur shale loam. Areas of this texture occur east of Harvey along the State road. A few smaller spots of like character are scattered throughout the gravelly loam areas. The Upshur shale loam fine earth has about the same texture as that of the Upshur gravelly loam, but the color of both soil and subsoil are more intense.

The areas of the Upshur gravelly loam are confined to the extreme western part of the county. The type is inextensive. It is well developed on the ridge to the west of Ditch Run and also east of this stream. A narrow belt occurs between Tonoloway Ridge and the Potomac River southwest of Roundtop. The largest area extends from the river near Pearre to the Pennsylvania line east of Sideling Hill. Another belt occurs west of the same mountain bordering Sideling Hill Creek.

The Upshur gravelly loam in general occupies ridges in valleys and has a rolling to hilly topography. Its position gives much of it excessive drainage, and erosion about keeps pace with soil formation, resulting in a shallow soil with much outcropping rock on the steeper slopes.

Comparatively little, probably not over 20 per cent, of this type is under cultivation. The rest supports a mixed forest consisting principally of various kinds of oak, some chestnut, and scattering pines.

The Upshur gravelly loam is an easy soil to work, and crops mature on it early, but it is inclined to be droughty. The area farmed is

used for the production of general farm crops and fruit. The yield of corn ranges from 15 to 30 bushels, wheat 10 to 20 bushels, and hay $\frac{1}{2}$ to 1 ton per acre. The fruit consists of apples and peaches, both of which do well.

Land of this type brings from \$20 to \$100 an acre.

To maintain or increase the productiveness of the Upshur gravelly loam, organic matter in the form of stable manure or green-manure crops should be incorporated. This will improve its mechanical condition and increase its power to hold water. From the success attained with fruit, it would seem that the industry could be profitably extended in the more favorable positions. The rougher and more broken country should be used for permanent pastures or allowed to reforest.

ASHE STONY LOAM.

The Ashe stony loam, as typically developed, is a greenish-brown silt loam to silty clay loam, about 6 inches deep, underlain by yellowish-brown silty clay with a slight greenish cast. Large and small fragments of the parent greenstone are present in sufficient quantity to give the land a decidedly stony character. The subsoil is friable, partly on account of the large proportion of small rock fragments it contains.

This type has only a small extent in Washington County. It occurs in irregular areas or patches from the northeastern corner of the county to Harman Gap, and in larger areas from Fox's Gap to Weverton.

Practically all of it supports a mixed forest of oak, hickory, locust, chestnut, and maple, with an undergrowth of briers, grape vines, hazel brush, and less commonly, sumac. This type has no value except for pasture land. Bluegrass seems to thrive between and around the rocks.

ASHE GRAVELLY LOAM.

The soil of the Ashe gravelly loam consists of a brownish silt loam 8 to 16 inches deep. The subsoil is a yellow friable silty clay extending to a depth of 3 feet or more. Both the soil and subsoil have a distinct greenish cast and in this particular differ from typical Ashe material. Over the surface and throughout the soil section is an abundance of partially decomposed greenstone gravel.

Included with this type are local spots of Ashe silt loam, Porters silt loam, and Porters gravelly loam too small to show on a map of the scale used in this survey.

This type is one of the inextensive soils of the county. It is confined to the eastern half of the area, particularly on the ridge of South Mountain bordering the Frederick County line from the north-

eastern corner of the county to west and southwest of Harman Gap, also, on the lower slopes of South Mountain and Elk Ridge from east of Rohrsersville to the Potomac River. Where the Ashe silt loam occupies the tops of ridges the surface of the gravelly loam is generally smoother and the topography gently sloping to rolling. In the valley section the type occupies knobs and low hills. It is generally well drained and, although its position would seem to promote excessive drainage in places, comparatively little erosion takes place.

Probably 80 per cent of the type is under cultivation, the rest of it supporting a mixed forest of poplar, oak, hickory, walnut, maple, chestnut, and locust, with an undergrowth of briers, hazel brush, and grapevines.

This soil is used for the ordinary general farm crops of the region. Much of the type, however, is kept in pasture for long periods, the sod being of good quality and very durable. The yield of corn ranges from 15 to 40 bushels, wheat 10 to 20 bushels, and hay about 1 ton per acre.

In the northern extension of the type, in the vicinity of Highfield, a few orchards have been set out and are in fine condition. The trees are large, and the fruit is said to be of excellent quality. It would seem that fruit growing, especially the production of apples, could be profitably extended.

Land of this type of soil is held at \$40 to \$150 an acre.

ASHE SILT LOAM.

As typically developed, the soil of the Ashe silt loam consists of a brownish-yellow silt loam from 6 to 12 inches deep. The subsoil is a yellow, friable light silty clay, which usually exceeds a depth of 3 feet. Over the surface is a slight scattering of quartz, sandstone, and quartzite gravel, but not in sufficient quantities to warrant separation as the Ashe gravelly loam. Included with the type are local spots of Ashe silty clay loam, too small to separate. These represent areas of the Ashe silt loam from which the surface soil has been wholly or partially removed by erosion. A more important variation is an inclusion which might be classed as Chandler¹ silt loam. This has all the characteristics of typical Chandler, except that the content of mica is lower. The material is derived from mica schists and other altered rocks. The variation occurs in very narrow belts and so closely associated with the typical Ashe silt loam that no separation could be made.

Another important inclusion in the Ashe silt loam as mapped consists of some Lickdale silt loam in the valley between Cascade and

¹The Chandler soils are mountain soils derived from crystalline schists. They have grayish to light brownish surface soils and yellowish subsoils containing enough mica to give a greasy feel.

the Pennsylvania State line. This is a brown, brownish-black, and grayish silt loam, underlain at 6 to 10 inches by bluish-gray silty clay, mottled with yellow and rusty brown. It occupies flattish valley areas and gentle lower slopes and the drainage is imperfect. The material is probably colluvial from associated Dekalb and Ashe areas. Hay and corn in places seem to do well on it.

The typical Ashe silt loam occurs between South Mountain and Elk Ridge along Israel Creek, particularly east of Gapland and in vicinity of Rohrsersville. It occupies gently rolling valley country and is generally well drained, with local spots excessively drained, especially on the slopes.

Although the type is of small extent, it is of some importance, being one of the more productive types of the county. It is used for general farming. Corn yields from 20 to 40 bushels, wheat 10 to 30 bushels, and hay from 1 to 1½ tons per acre.

The Ashe silt loam is an easy soil to work, and crops can be produced economically, as the surface features are favorable for the use of all labor-saving machinery.

Land of this type is held at \$80 to \$150 an acre, depending on location, improvements, etc.

FRANKSTOWN SILT LOAM.

The Frankstown silt loam, as typically developed, consists of a brown or yellowish-brown silt loam, 8 to 12 inches deep, underlain by a yellow friable silty clay loam or silty clay which rarely exceeds a depth of 3 feet. The soil material rests upon a massive, cherty or shaly limestone, variable in texture or structure, from which the soil has been derived. In places fragments of the rock are encountered throughout the soil section and upon the surface, and where they are abundant the areas are marked on the map by symbols. In one such area occurring in the vicinity of Smithburg and Cavetown the gravel also includes sandstone and quartzite from South Mountain.

The typical Frankstown silt loam occurs in the south-central part of the county and is most largely developed north, south, and west of Sharpsburg. Detached areas lie east and west of Beaver Creek, also south of Roxbury, and around Ringgold. It is one of the less extensive soils of the area, but important agriculturally. Practically all of it, except the gravelly areas, which are used more for the production of fruit, for which they are better adapted, is used for the general farm crops.

The surface in general is gently rolling with some steep slopes along streams. The drainage varies from good to excessive, the latter condition occurring in areas of shallow soil.

The Frankstown silt loam is an easy soil to work, most of the surface being smooth enough to allow the use of machinery. Corn, wheat, and hay are the leading crops. Corn yields from 20 to 50 bushels, wheat 15 to 30 bushels, and hay from 1 to 1½ tons per acre.

Land of this type of soil brings from \$100 to \$200 an acre.

WAYNESBORO GRAVELLY SANDY LOAM.

The surface soil of the Waynesboro gravelly sandy loam consists of a brown sandy loam from 6 to 12 inches deep. The subsoil is a reddish-yellow, yellowish-red, or red sandy loam which passes rather abruptly into a red sandy clay, usually becoming heavier with depth and resting directly upon bedded gravel or residual fragments of shale, limestone, or sandstone rocks. Over the surface and throughout the soil section is an abundance of rounded sandstone and quartzite gravel.

The material composing this type is alluvial and represents remnants of old river terraces lying above overflow. These terraces are much dissected and have lost most of the characteristic terrace topography.

The Waynesboro gravelly sandy loam is one of the inextensive soils of the county. It is well developed along Conococheague Creek north and south of the State road, along the Potomac River in the vicinity of Ernstville and Big Pool, and south of Charlton. Other areas lie along Falling Waters Road and south of Dellinger School.

The topography is gently rolling to rolling. Drainage is good to excessive. Erosion is more or less active and the surface soil has been partially or wholly removed in some areas.

The Waynesboro gravelly sandy loam, notwithstanding the gravel content, is comparatively easy to work. Crops mature on it early, and rarely suffer from drought, except in spots where drainage is excessive. Practically all the type is used for general farming. Corn, the leading crop, yields from 15 to 35 bushels, wheat from 10 to 20 bushels, and hay from one-half to three-fourths ton per acre. These yields show the soil to be of only moderate productiveness.

Some excellent stands of red clover were noted on this type, and a few experimental fields of alfalfa suggested by their vigorous appearance that this crop might be grown successfully on a larger scale. The fruit trees seen were thrifty, but the peach crop is sometimes lost on account of late spring frosts.

Land of this type is held at \$75 to \$100 an acre.

Waynesboro gravelly sandy loam, heavy phase.—The soil of the Waynesboro gravelly sandy loam, heavy phase, consists of a mellow brown sandy loam or silt loam from 8 to 12 inches deep. The subsoil is a yellowish clay or clay loam which grades into rather stiff red-

dish clay at depths ranging from 15 to 24 inches, which usually persist to a depth of 3 feet or more, where it rests upon bedded gravel or the residual material from shale, limestone, or other rocks. Over the surface and throughout the soil section is an abundance of well-rounded sandstone and quartzite gravel, the particles ranging from 2 to 4 inches in diameter.

Included with this phase, are small areas from which the surface soil has been partly or wholly removed by erosion, exposing the underlying clay or gravel. No separation of these was made, owing to their small extent.

This heavy phase is unimportant, covering in all an area of 2 square miles. The better developed areas lie east of the mouth of Licking Creek, and also in the vicinity of Ernstville and on the uplands between Terrapin Neck and Antietam. It occupies the tops of ridges or higher slopes near the Potomac River, and represents remnants of old terraces which have to a great extent lost their terrace character, being identified as alluvial only by the nature of the soil materials. In general, the drainage is good, and in local areas excessive.

Practically all this soil is farmed. Corn, wheat, and hay are the important crops. The yield of corn ranges from 20 to 40 bushels, wheat from 10 to 20 bushels, and hay from one-half to 1 ton per acre.

The price of land of this phase ranges from \$75 to \$100 an acre.

HOLSTON SILT LOAM.

The Holston silt loam, consists of a brown or light-brown mellow silt loam from 6 to 12 inches deep, underlain by a yellow silt loam grading into yellow, heavy silty clay. The soil material generally exceeds a depth of 3 feet. In places the yellow silty clay may be mottled with red or brown near the bottom of the 3-foot section.

Included with this type, but distinguished by gravel symbols, are spots where much gravel appears on the surface or mixed with the fine earth throughout the soil section.

The Holston silt loam occupies terraces usually lying between the bottoms composed of the Pope silt loam and higher terraces or uplands. In places, however, where the channels of the water-courses are deep and the Pope is missing the Holston occupies the bluffs along the streams. The type is formed from old alluvium derived largely from sandstone and more rarely from shale.

It is a soil of small extent. The important areas lie along the Potomac River southwest of Hancock and southeast along the river to Williamsport. It has a flat to gently rolling surface and is well drained.

This is an easy soil to work, although in places gravel interferes somewhat with tillage operations. The soil retains fertilizer well and there is comparatively little loss of fertility from leaching. It includes little or no waste land.

Practically all this type is under cultivation, being used for the general farm crops common to the region. Reported yields show it to be a soil above the average productiveness, corn giving 30 to 50 bushels, wheat 10 to 30 bushels, and hay from 1 to 1½ tons per acre.

Land of this type is held at \$80 to \$150 an acre.

ELK SILK LOAM.

The surface soil of the Elk silt loam consists of a mellow silt loam of brown or light-brown color ranging in depth from 6 to 12 inches. The subsoil is a yellow compact silt loam which quickly passes into a yellow or brownish-yellow silty clay loam or silty clay, extending to a depth of 3 feet or more. In places bordering the uplands the subsoil is mottled with gray or reddish-brown.

Included with this type are a few spots of Elk sandy loam, the larger of these occurring in an old cut-off of Little Antietam Creek about one-half mile south of the State line and in the vicinity of Weltys Church, extending along the stream toward Edgemont. There are also included spots of Elk gravelly loam, which are indicated on the soil map by gravel symbols. This does not differ materially from the silt loam except in the presence of an abundance of well-rounded sandstone and quartzite gravel. There are likewise mapped with the silt loam spots of Elk silty clay loam. These consist of very small areas or narrow strips lying usually in slight depressions of generally poor drainage. They are confined to the bottoms along the Conococheague Creek.

The Elk silt loam is developed principally in the eastern part of the county, where it occurs on the second bottoms and terraces of Conococheague Creek and other streams flowing through the valley divisions. It is well developed about the headwaters of Beaver Creek near Cavetown and around the headwaters of Antietam Creek. It forms flat and gently rolling areas and is generally well drained. There are, however, a few level places and slight depressions which receive seepage water from the adjacent uplands, and are inadequately drained.

Practically all of this type is utilized for the production of the general farm crops. It is a good grass soil and the pasturage is above the average. The yields of all crops, while not as large as on the limestone soils, are better than on the lighter-textured terrace and mountain soils. Corn yields from 30 to 60 bushels, wheat 10 to 20 bushels, and hay 1 ton per acre.

This soil ranges in price from \$80 to \$150 an acre.

The Elk silt loam is handled in practically the same way as the adjoining upland soils, the methods being for most part well adjusted to the conditions. Some of the flatter and wetter areas need artificial drainage to fit them for profitable cropping. This can be accomplished either by means of open ditches or tile drains.

POPE FINE SANDY LOAM.

As typically developed, the soil of the Pope fine sandy loam consists of a brown or dark-brown fine sandy loam, 6 to 12 inches deep. The subsoil consists of a light-brown or yellowish-brown fine sandy loam to light fine sandy clay loam, extending to a depth of 3 feet or more.

Included with this type are local spots of Pope gravelly fine sandy loam or Pope silt loam, the former occurring on smaller streams near the mountains and the latter where the type is developed in the wider bottoms. A few areas of sandy soil border the canal and river near Weverton.

Typical areas of the Pope fine sandy loam are confined to the flood plains of the Potomac River and some of its tributaries west of Licking Creek, especially Sideling Hill Creek, and its confluent, Bear Creek, and Little and Great Tonoloway Creeks. The surface is flat or slightly inclined toward the streams. It is subjected to occasional overflow, but water does not remain on the surface long after the streams subside. The type has been formed of materials derived chiefly from the Dekalb and Upshur soils.

Nearly all of this type is under cultivation, being used mainly for the production of corn and hay. Corn may be grown for several years in succession. The yields range from 30 to 50 bushels per acre. The yield of hay is above the average, ranging from 1 to 1½ tons per acre.

This is a valuable soil, prices ranging from \$80 to \$150 an acre.

The following table gives the results of mechanical analyses of the soil and subsoil of the Pope fine sandy loam:

Mechanical analyses of Pope fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
201325.....	Soil.....	0.3	1.0	2.6	27.4	23.4	15.0	30.4
201326.....	Subsoil.....	.1	.6	1.7	26.8	24.1	31.6	15.2

POPE SILT LOAM.

The soil of the Pope silt loam consists of a brown silt loam or heavy silt loam from 8 to 14 inches deep. The subsoil is a yellowish-brown or dark-yellow silty clay loam usually becoming a silty clay

with increased depth and in places mottled with rusty brown spots near the bottom of the 3-foot section.

Included with this type are some areas that have sandstone and quartzite gravel scattered over the surface. These occur in close proximity to the mountains and represent material washed from the mountain slopes. They are shown on the accompanying map as Pope silt loam with gravel symbols.

Another important inclusion consists of an area lying along Israel Creek. Here the soil is about the same in texture but contains much mica in the lower subsoil, this probably being derived from the mica schists of the section. This variation is not so well drained as the areas of typical soil. Besides the above variation some small spots of Pope fine sandy loam were encountered. These were not of enough importance to warrant separation.

The Pope silt loam is derived largely from materials washed from the Dekalb, Berks, and Upshur soils. These materials have been transported and deposited in the present flood plains of the streams during periods of overflow. The silt loam occupies the same position in relation to the streams as the Pope fine sandy loam, except along the Potomac River where it lies somewhat higher and is not so frequently overflowed.

The Pope silt loam is more extensive than the Pope fine sandy loam. It is well developed along the bottoms of the Potomac River and its tributaries draining the more mountainous country, in the region west of Fairview Mountain and east of Licking Creek, and also along the drainage from South Mountain and Elk Ridge, especially the headwaters of Little Beaver Creek. Where the type borders the river the belts are well developed but not continuous.

The surface of the Pope silt loam is usually flat, with a slight slope toward the streams, except along the river where it is in many places higher near the river than at the edge of the uplands. All the type is fairly well drained except in local spots in the areas along the river where the drainage may be poor, especially near the uplands. In some cases the type is subject to the accumulation of seepage waters from the bluffs.

The Pope silt loam is more difficult to keep in good tilth than the Pope fine sandy loam, and crops are generally slower in the early stages of growth, but it is considered a strong productive type, especially for corn and grass. The yields of corn reported range from 40 to 80 bushels, and of hay from 1 to 2 tons per acre.

Lands of this type bring from \$80 to \$200 an acre.

Lime and stable manure, while not so necessary as on the upland soils directly to maintain productiveness, would do much to improve the tilth of this type and increase the yields of crops through im-

provement in its physical condition. Drainage is another step in the same direction.

DUNNING SILTY CLAY LOAM.

The Dunning silty clay loam consists of a light textured black silty clay loam from 10 to 14 inches deep, underlain by a gray silty clay mottled with white, changing in the lower part of the profile to a mottled drab and yellow heavy plastic clay. Small included areas have a dark gray instead of black color.

Some spots mapped with this type are mined for the marl. Such areas, which have a calcareous or marly subsoil, do not belong in the Dunning series. Only a small area of the Dunning silty clay loam is mapped in Washington County. It is well developed in the bottom west of Hagerstown, particularly near the county home, and other areas occur throughout the first bottoms of the streams in which the Huntington silt loam is the characteristic soil.

The surface of the Dunning silt loam is generally flat or inclined slightly toward the streams. The type is poorly drained in places.

Nearly all of this soil is used for the production of grass and corn, for which it is well adapted, corn yielding from 40 to 80 bushels and hay from 1 to 2 tons per acre.

These areas have been formed by precipitation from lime-impregnated water, probably at some time when their flow was obstructed and they spread out in ponds or marshes.

Land of this type is usually sold with other soils. The price ranges from \$80 to \$200 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dunning silty clay loam:

Mechanical analyses of Dunning silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
201305.....	Soil.....	3.0	5.6	2.5	7.5	11.7	49.5	20.1
201306.....	Subsoil.....	.9	2.0	1.4	5.5	16.4	44.4	29.5

HUNTINGTON SILT LOAM.

The soil of the Huntington silt loam, as typically developed, consists of a brown mellow silt loam or heavy silt loam. The subsoil is a brown or yellowish-brown silty clay, which becomes lighter in color with depth, the lower part in places being mottled with rusty brown or bluish spots.

Included with this type are spots of Dunning silty clay loam, Huntington fine sandy loam, and Huntington gravelly loam. The Dunning silty clay loam is usually separated from the other variations which usually lie on or near the stream channels. All these variations, however, are local and could not be shown satisfactorily on a map of the scale used in this survey.

The Huntington silt loam is a first-bottom soil composed largely of materials washed from limestone soils. It occurs in narrow belts along the streams rising in or flowing through the limestone areas. It is in general subject to occasional overflow, and some areas lying along smaller streams to frequent overflow. Except in local spots, the soil is well drained.

The Huntington silt loam, which is an inextensive soil in Washington County, is confined to the bottoms of the streams in the central part of the county east of Fairview Mountain and west of South Mountain.

Nearly all this type is utilized either for the production of corn and hay or as pasture land. Some wheat also is grown, but the crop is successful only on the areas where overflows are infrequent. The yield of corn ranges from 30 to 75 bushels and of hay from 1 to 2 tons per acre.

Land of this type is somewhat difficult to handle. If plowed when too wet it does not scour from the plow and if too dry it turns up in clods. It is, however, well adapted to the production of grass and corn, and, judging from small patches growing at the time of the survey, alfalfa also does well.

Land of this type is usually sold with surrounding soils, which usually range in price from \$80 to \$20 an acre.

ROUGH STONY LAND.

Rough stony land represents a condition rather than a soil type. It embraces those rough, broken, and steep areas of nonagricultural land, thickly strewn with rock or cut by rock outcrops.

Areas of this description occur throughout Bear Pond Mountain and in many places on the crests and slopes of South Mountain. It is also developed in places on Elk Ridge. In some of the more favorably situated spots, the rocks could be removed and the land used for orchards. Some areas afford scanty pasturage. Most of it supports a mixed forest of oak, hickory, and chestnut, with some pine. It is usually valued only for the timber on it.

SUMMARY.

Washington County has an area of 459 square miles or 293,760 acres. It lies in the northwestern part of the State, wholly within the Appalachian and Limestone Valley provinces and comprises

three physiographic divisions, South Mountain, an extension of the Blue Ridge Mountains of Virginia, the Great Valley, or Hagerstown Valley, which is a continuation of the Shenandoah Valley, and the Appalachian section. The topography ranges from gently rolling in the great valley to rolling or hilly, or mountainous in the Appalachian section.

The elevation of the county ranges from 280 to 2,145 feet above sea level, with the greater part of its area lying between 400 to 800 feet above sea level.

The county is thickly settled. According to the census of 1910 there was a population of 33,110, or 72.1 persons to the square mile.

An excellent system of general farming has been established, and fruit growing is of commercial importance. Crop rotation is generally practiced and commercial fertilizers are extensively used, while stable manure and lime are generally applied to the fields. Wheat, corn, and hay are the principal general farm crops. These crops are supplemented by garden truck produced for home consumption and local markets. The feeding of live stock and dairying are also important industries.

There is a great diversity of soils in the county, representing differences in origin, position, and drainage. There is comparatively little extremely sandy loam, or heavy clay soil, the loam, silt loam, and clay loam textures predominating.

Twenty-five types of soil, four of them with phases, not including Rough stony loam, are mapped. These are grouped in series.

The Hagerstown series occupies more territory than any other. The soils of this series are derived from limestone and are the most valuable types for general farming. The Hagerstown silt loam and clay loam are the most important soils of this series.

The Berks series also is extensive. These soils are derived from shale and are not as valuable for general farm crops as the Hagerstown soils. The yields of such crops are generally light. The soils are better adapted to fruit, and especially to apples.

The Murrill gravelly loam, the only representative of the Murrill series, produces fair yields of the general farm crops, but is especially valuable for peach growing.

The Dekalb soils are not so well adapted to general farming as the valley soils, the gravelly loam and stony loam in particular generally having a surface too steep to allow the use of farm machinery. The earliest peaches, however, are obtained in orchards on the Dekalb gravelly loam, colluvial phase. This soil also gives better yields of the general farm crops than any of the other Dekalb soils.

The types of the Porters and Ashe series are strong soils for the production of general farm crops, the gravelly loam and silt loam

being especially valuable for the purpose. The Ashe gravelly loam in addition is an excellent soil for apples. The stony loams have little value except for pasture land.

The Clarksville gravelly loam, the only representative of the Clarksville series in the county, is of small extent. It is a strong soil for general farm crops and a very valuable one for apple production.

The Hanceville series is represented in the county by the Hanceville gravelly loam. This soil is fairly productive and valued both for the growing of general farm crops and of apples.

One type in the Upshur series is mapped, the Upshur gravelly loam. This as a moderately productive general farming soil and a valuable soil for apple production.

The Elk and Holston soils, terrace soils, are strong soils for the production of general farm crops.

The Pope soils are first bottom types especially desirable in the production of corn and grass. The former is inclined to poor drainage in places.

The Dunning and Huntington soils, also first bottom types, are exceptionally good soils for corn and grass.



[PUBLIC RESOLUTION—No. 9.]

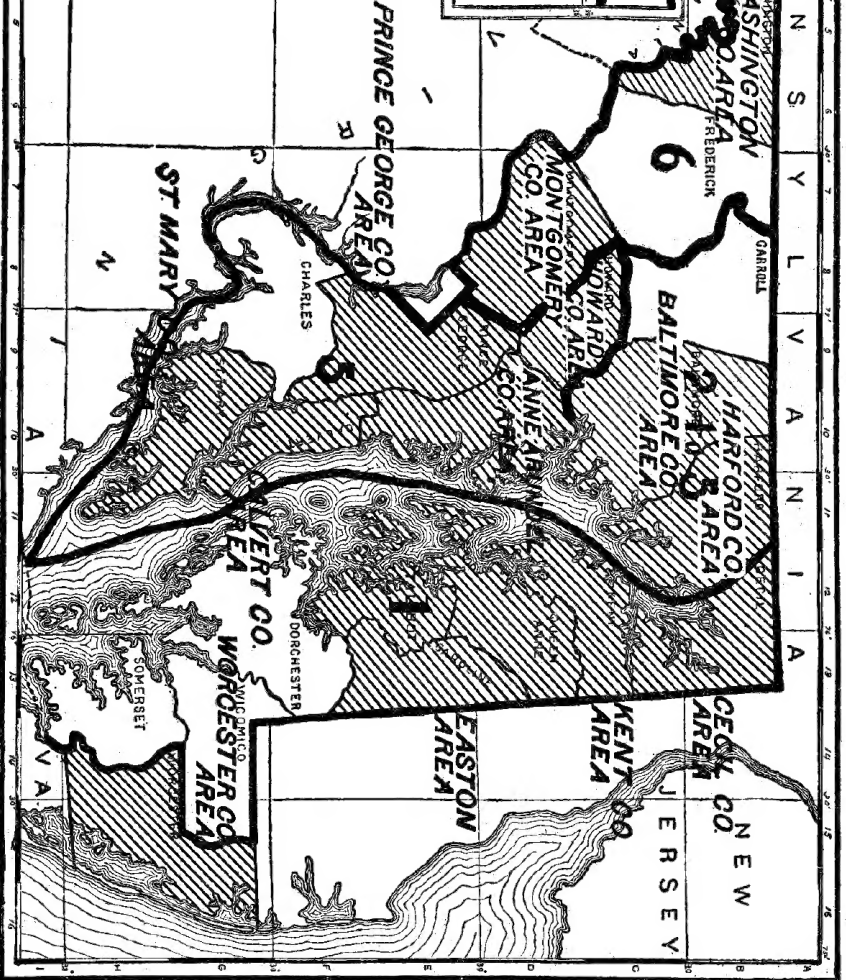
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Maryland.

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